D5-13424

FINAL TECHNICAL REPORT PROTOTYPE 20 WATT SOLID-STATE TELEMETRY TRANSMITTER

VOLUME II OF III

April 1, 1968

THE BOEING COMPANY - SPACE DIVISION

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TITLE FINAL TECHNICAL REPORT - PROTOTYPE 20 WATT, SOLID-STATE TELEMETRY TRANSMITTER

MODEL NO. CONTRACT NO. NAS8-20777

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TELEMETRY SYSTEMS

APRIL 1, 1968

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CONTENTS

ILLUSTRATIONS

TABLES

1.0 INTRODUCTION

This section contains the procedure for testing the 20 Watt Telemetry Transmitter.

1.1 TEST PROCEDURES

Unless otherwise agreed to by the MSFC Contracting Office Representative (COR) and Boeing test engineers, the test procedures and test equipment included herein are to be utilized to accomplish all tests. Any changes to the test procedures and/or test equipment being used will be coordinated with the MSFC-COR prior to initiation of the test.

1.2 TEST EQUIPMENT

The test equipment specified herein (Table 2), or equivalent, will be provided for the performance of the required tests. All electronic test equipment will be marked certified as being capable of performing within the limits of the applicable certification procedure approved by the MSFC-COR. Certification data will be recorded on a test equipment list pertinent to each sequence of tests performed.

1.3 TESTS

The tests shall consist of all the performance and environmental tests included herein. Test data shall be recorded on a suitable form.

1.3.1 Test Sequence

The sequence of testing will be controlled by laboratory and test equipment availability with the following exceptions:

a. Performance tests shall be conducted first.

b. After all environmental tests have been conducted, performance tests shall be repeated.

c. During environmental testing, vibration tests shall be conducted last.

1.3.2 Performance Tests

The transmitter shall be performance tested in accordance with the following procedures:

1.3.2.1 Test Setup

a. Mount transmitter on heat sink. The temperature of the heat sink shall be monitored by a thermocouple attached to the heat sink one inch from the transmitter. Heat sink temperature shall not be permitted to exceed 75°C. Before mounting, coat the contacting surfaces of the transmitter and thermocouple with a layer of heat-conducting silicone grease (Dow Corning 340 or equivalent).

b. Use ohmmeter to check for high resistance (over 10 megohms) between chassis ground, power ground, and input signal ground terminals.

1.3.2.1 Test Setup (Cont'd)

c. Pressurize transmitter to approximately 21 psig using dry gaseous nitrogen. Purge the residual air from the unit while pressurizing.

d. Measure and record the transmitter pressure after a 24-hour period.

e. Reduce transmitter pressure to approximately 7 psig.

1.3.2.2 Output Power, Frequency Stability, and dc-RF Efficiency

a. Assemble the test setup of Figure 1.

b. Before connecting the dc power supply, turn on all test equipment and allow proper warmup time. Adjust the supply voltage to 28.0 Vdc.

c. Apply power to the transmitter.

d. With no input to the transmitter measure and record supply voltage, supply current, output power, and output frequency.

e. Set the supply voltage at plus 24.0 V dc and repeat step (d).

f. Set the supply voltage at plus 32.0 V dc and repeat step (d).

g. Account for coupling and insertion losses for directional coupler, coaxial line and fittings. Correct output power readings obtained by adding these losses to the readings taken.

h. Calculate the overall dc to RF conversion efficiency, for each power supply voltage setting above, as follows:

$$\%\ EFF = \frac{\text{Corrected RF output power}}{(I\ dc)(V\ dc)} \times 100$$

1.3.2.3 Warmup Time

a. Assemble basic test set in accordance with Figure 1.

b. Before connecting the dc power supply, turn on all test equipment and allow proper warmup time. Adjust the supply voltage to 28.0 V dc.

c. The transmitter shall be denergized for at least a 2-hour period.

d. Apply power to the transmitter and at 3, 6 and 9 minutes after applying power record power output and the output frequency.

1.3.2.4 Input Impedance

1.3.2.4.1 DC Input Impedance

a. Assemble the test setup of Figure 2.

b. Adjust the dc voltage source for 1.0 V dc.

1.3.2.4.1 DC Input Impedance (Cont'd)

c. Adjust the decade resistance until the input to the transmitter is 0.5 V dc.

d. Read and record the decade resistance as the dc input impedance.

1.3.2.4.2 AC Input Impedance

a. Assemble the test setup of Figure 3.

b. Adjust power supply to plus 28 V dc and variable resistor to zero resistance.

c. Set audio oscillator frequency at 300 Hz. Adjust oscillator output voltage for 1.0 VRMS across the signal input lines, as measured at the input connector pins.

d. Adjust variable resistor until the voltage measured across the transmitter input is one-half that across the oscillator terminals.

e. Measure and record the resistance of the variable resistor as the input impedance at 300 Hz.

f. Repeat steps (c), (d), (e) for audio oscillator frequencies of 1 KHz, 10 KHz, 50 KHz, 100 KHz and 200 KHz.

1.3.2.5 Deviation Sensitivity

1.3.2.5.1 AC Sensitivity

a. Test setup shall be in accordance with Figure 4.

b. Adjust power supply voltage to 28 V dc.

c. Tune the spectrum analyzer to the unmodulated carrier frequency of the transmitter and monitor the carrier amplitude.

d. Set audio oscillator frequency at 41.67 kHz and maintain throughout this test. (This frequency when multiplied by a modulation index of 2.40 results in a peak carrier deviation of 100 kHz.)

e. Increase the audio oscillator output voltage until the first carrier null (carrier amplitude equals zero) occurs. This represents a peak carrier deviation of 100 kHz. Measure and record the modulation input voltage at the transmitter.

f. Compute the deviation sensitivity as follows:

$$\text{Deviation sensitivity} = \frac{100\ \text{kHz}}{\text{Modulation Voltage (rms)}}$$

g. Adjust power supply to 32.0 V dc and repeat steps (e) and (f).

h. Adjust power supply to 24.0 V dc and repeat steps (e) and (f).

1.3.2.5.2 DC Sensitivity

a. Test setup shall be in accordance with Figure 5.

b. Adjust power supply to 28.0 Vdc.

c. Apply +1.0 Vdc across the modulation input leads. Record the RF carrier frequency.

d. Apply -1.0 Vdc across the modulation input leads. Record the RF carrier frequency.

e. Repeat (c) and (d) at a supply voltage setting of 32.0 Vdc.

f. Repeat (c) and (d) at a supply voltage setting of 24.0 Vdc.

1.3.2.6 AC Deviation Linearity

a. Test setup shall be in accordance with Figure 4.

b. Adjust power supply voltage to 28 Vdc.

c. Set audio oscillator at 300 Hz.

d. Set the audio oscillator output voltage at 2.50 Vrms (500 kHz deviation).

e. Adjust the receiver video output for a convenient level. Maintain the same receiver video gain control setting throughout the following steps.

f. Measure and record the receiver video output (Er) and modulation input voltages (Vi) to three decimal places for modulation input increments of 0.250 V from 0.250 V to 2.500 V and at 0.625 V.

g. Set the audio oscillator at 10 kHz.

h. Repeat steps (d), (e) and (f).

i. Set the audio oscillator at 100 kHz.

j. Repeat steps (d), (e) and (f).

k. At each of the modulation frequencies calculate the percent deviation linearity in accordance with the following procedure:

(1) Calculate the theoretical deviations as follows:

125 kHz Deviation

$$E_t = E_{0.625} \frac{V_i}{0.625}$$

500 kHz Deviation

$$E_t = E_{2.500} \frac{V_i}{2.500}$$

1.3.2.6 AC Deviation Linearity (Cont'd)

wherein:

E_t = Theoretical receiver output for the associated increment of input modulation voltage.

V_i = Input modulation increment voltage.

$E_{0.625}$ = Receiver video output voltage for 0.625 modulation input voltage.

$E_{2.500}$ = Receiver video output voltage for 2.500 modulation input voltage.

(2) Select the point of greatest difference between the theoretical deviation (E_t) and the actual deviation (E_r) recorded.

(3) Calculate and record the maximum percent linearity as follows:

125 kHz Linearity

$$\%\ \text{Linearity} = \frac{E_t - E_r}{E_{0.625}} \times 100$$

500 kHz Linearity

$$\%\ \text{Linearity} = \frac{E_t - E_r}{E_{2.500}} \times 100$$

1.3.2.7 Frequency Response

a. Test setup shall be in accordance with Figure 6.

b. Adjust power supply to plus 28 V dc.

c. Set the oscillator frequency to 50 kHz. Adjust the audio oscillator output voltage for 0.625 Vrms. Measure and record the receiver video output voltage and modulation input voltage.

CAUTION: DO NOT ADJUST THE RECEIVER VIDEO GAIN CONTROL DURING THE FOLLOWING TEST STEPS:

d. Adjust the audio oscillator for frequencies specified below. At each frequency setting maintain the modulation input voltage measured in step (c). Measure and record the receiver output voltage at each frequency.

Audio Oscillator Frequency Settings

50 Hz	150 kHz
200 Hz	200 kHz
500 Hz	250 kHz
1 kHz	300 kHz
5 kHz	350 kHz
10 kHz	400 kHz
50 kHz	450 kHz
100 kHz	500 kHz

1.3.2.7 Frequency Response (Cont'd)

e. Determine the frequency response of the transmitter over the measured frequency range by the following equation:

$$\text{Frequency response (db)} = 20 \log \frac{E_s}{E_{50}\ \text{kHz}} - \text{SCF}$$

where Es = Receiver video output voltage

E_{50} kHz = Receiver video output voltage @ 50 kHz

SCF = System response correction factor in db.

NOTE: The SFC will be used as applicable in the test report only. During test the receiver tuning offset, I.F. bandwidth and video filtering used, should be recorded.

1.3.2.8 Incidental Frequency Modulation

a. Test setup shall be in accordance with Figure 7.

b. Adjust power supply to plus 28 V dc.

c. Calibrate receiver video output and scope in kHz deviation as follows:

(1) Tune spectrum analyzer to the unmodulated carrier output of the transmitter. Monitor carrier amplitude.

(2) Adjust audio oscillator frequency to 13.3 kHz. (This frequency when multiplied by a modulation index of 2.40 results in a peak carrier deviation of 32 kHz.)

(3) Increase audio oscillator output voltage until the first carrier null occurs. This represents a peak carrier deviation of 32 kHz.

(4) Adjust video output of receiver and/or scope sensitivity for a scope presentation of at least 8 kHz per centimeter.

CAUTION: DO NOT ADJUST THE RECEIVER VIDEO OR OSCILLOSCOPE GAIN CONTROLS DURING THE FOLLOWING STEPS.

d. Short circuit modulation input leads.

e. Measure and record transmitter peak-to-peak deviation, as displayed on scope.

f. Record receiver bandwidth used and receiver input signal level.

1.3.2.9 Modulation Distortion

a. Test setup shall be in accordance with Figure 8.

b. Adjust power supply to plus 28 V dc.

c. Adjust audio oscillator voltage to 0.625 Vrms and frequency to 5kHz. Adjust receiver output voltage as required for operation of the wave analyzer.

1.3.2.9 Modulation Distortion (Cont'd)

d. Measure and record input modulation frequency and amplitude. At the receiver output measure and record (in dB) the amplitude of the fundamental modulating frequency, and the amplitude of the second and third harmonics of the fundamental frequency.

e. Set the audio oscillator to the following frequencies sequentially, and, at each frequency, repeat steps (c) and (d).

5 kHz
10 kHz
25 kHz
50 kHz
100 kHz

1.3.2.10 Intermodulation Distortion

a. Test setup shall be in accordance with Figure 9.

b. Use two audio oscillators to simulate SCO1 and SCO2 in various frequency combinations as specified in Table 1.

c. Set the power supply voltage to 28 Vdc.

d. Set up combination number 1, shown in Table I. Adjust the oscillator amplitude controls to obtain 0.1 Vrms across the 1K ohm resistor for each frequency (measure with wave analyzer).

e. With the wave analyzer, read and record the ratio of the receiver video signal level of the sum and difference frequencies shown in Table I with respect to the signal level of the SCO frequencies.

f. Repeat steps (d) and (e) for the remaining combination frequencies specified in Table I.

TABLE 1-I INTERMODULATION DISTORTION

Combination Number	SCO #1 Center Frequency	SCO #2 Center Frequency	Sum	Difference
1	560 Hz	730 Hz	1290 Hz	170 Hz
2	2.3 kHz	3.0 kHz	5.3 kHz	700 Hz
3	14.5 kHz	22.0 kHz	36.5 kHz	7.5 kHz
4	40.0 kHz	70.0 kHz	110 kHz	30 kHz

1.3.2.11 Load Impedance

1.3.2.11.1 1.8 VSWR

a. Assemble test setup for reactive load in accordance with Figure 10.

1.3.2.11.1 1.8:1 VSWR (Cont'd)

b. Set the adjustable stub for a reactive load of 1.8:1 before connecting to transmitter output.

NOTE: Continuously monitor heat sink temperature and supply current. Heat sink temperature shall not be permitted to exceed 75°C.

c. Apply plus 28 Vdc to the transmitter.

d. Record supply current, output power, and output frequency.

e. Repeat step (d) for power supply settings of 24 Vdc and 32 Vdc.

1.3.2.11.2 Open Circuit

a. Test setup shall be in accordance with figure 1.

NOTE: Whenever the load is changed, allow sufficient time for output power to stabilize.

b. Record output power, supply current, and carrier frequency.

c. Disconnect 50-ohm load from the output terminal of the transmitter and operate the transmitter at 28.0 Vdc supply voltage for 15 minutes.

d. Reconnect 50-ohm load and record output power, supply current, and carrier frequency.

1.3.2.11.3 Short Circuit

a. Test setup shall be in accordance with Figure 1.

NOTE: Whenever the load is changed, allow sufficient time for the output power to stabilize.

b. Record output power, supply current, and carrier frequency. Disconnect the 50-ohm load from the output terminal of the transmitter. Connect a shorting plug directly to the output terminal of the transmitter.

c. Apply 28 Vdc and operate the transmitter with the output short circuited, for 15 minutes.

d. Reconnect the 50-ohm load. Measure and record output power, output frequency, and supply current.

1.3.2.12 Incidental Amplitude Modulation

a. Test setup shall be in accordance with Figure 11.

b. Set the supply voltage to plus 28.0 Vdc.

c. Short circuit the transmitter modulation input leads.

1.3.2.12 Incidental Amplitude Modulation (Cont'd)

d. Apply power to transmitter and adjust the attenuator to obtain a 1.0 mw output.

e. Set signal generator frequency to 2277.5 MHz. With modulation off, connect power meter to signal generator and adjust signal generator output controls to obtain a 1.0 mw output.

f. Connect the signal generator to the r-f detector and oscilloscope combination. Adjust the oscilloscope controls for a 5 cm dc deflection.

g. Amplitude modulate the signal generator with 10 KHz. Adjust the modulation source level to obtain a 1 cm peak-to-peak signal on the oscilloscope, this represents 20% AM. Adjust the oscilloscope controls to increase the peak-to-peak signal to 4 cm, centered on oscilloscope face. Each cm equals 5% of amplitude modulation.

h. Connect the signal out of the attenuator (transmitter output) to the r-f detector and oscilloscope combination, adjust the attenuator to position the sweep to the center of the oscilloscope face. Record the peak-to-peak amplitude of any signal or noise on the oscilloscope trace. This is incidental AM.

i. With oscilloscope and attenuator controls as in (h) above connect audio oscillator to the modulation input leads. Adjust audio oscillator voltage to 0.625 V vms and frequency to 10 KHz. Record the peak-to-peak amplitude of any signal or noise on the oscilloscope trace.

1.3.3 RFI

The transmitter shall be tested for generation of and susceptibility to RFI in accordance with Specification MIL-I-6181D, paragraphs 4.3.1.1, 4.3.3.2, and 4.3.4.1.2 only.

1.3.4 ENVIRONMENTAL TESTS

The transmitter will be subjected to the following environmental tests by Boeing. Preliminary setup will be as follows:

a. Reduce transmitter pressure to 7.0 $\pm$ 0.5 psig. Monitor pressure after each environmental test.

b. Mount transmitter on a suitable heat sink in accordance with Paragraph 1.3.2.1 (a). Heat Sink temperature shall be continuously monitored during test.

CAUTION: DO NOT UNDER ANY CIRCUMSTANCES ALLOW THE HEAT SINK TEMPERATURE TO EXCEED PLUS 75°C.

c. Energize the transmitter in accordance with Paragraph 1.3.2.2 and monitor the input voltage, input current, output power and output frequency during each test.

1.3.4.1 Temperature Shock (See note on Page 10)

a. Test the transmitter for resistance to temperature shock in accordance

1.3.4.1 Temperature Shock (Cont'd)

a. (Cont'd)

with Method 1 of Standard 50M60303 operating.

b. Perform two cycles between the high limit of plus 75°C and the low limit of minus 20°C.

c. Before and after this test and at the high and low temperature limits of each cycle, perform the following tests in accordance with the applicable paragraph:

Output power, frequency stability, and dc-RF efficiency

Deviation sensitivity

1.3.4.2 Temperature cycling (See Note)

a. Test the transmitter for resistance to extreme operating temperatures in accordance with Method 2 of Standard 50M60303.

b. Perform one cycle between the high limit of plus 75°C and the low limit of minus 20°C.

c. Before and after this test and at the high and low temperature limits, perform the following tests:

Output power, frequency stability, dc-RF efficiency and

Deviation sensitivity

1.3.4.3 Vibration

Conduct a sine wave vibration transmissibility test from 20-2000 Hz at a 5G level as follows:

a. Install accelerometers and mount transmitter on the test machine.

b. The vibration frequencies shall be swept logarithmically from 20-2000 Hz in at least two minutes. The sweep shall be performed once in each of the three planes.

c. During the above test, the transmitter shall be operated and the power output frequency and incidental frequency modulation recorded and monitored.

d. Before and after tests (each plane) record power output, frequency, incidental frequency modulation and efficiency.

NOTE: The high ambient temperature (75°C) will be determined by the temperature sensor in the heat sink. The low ambient temperature (-20°C) will be determined by the ambient air sensor in the temperature chamber.

TABLE 1-II LIST OF TEST EQUIPMENT

Item Number	Test Item
(a)	Spectrum Analyzer, Lavoie Laboratories Inc., Tuner Unit LA-18M and Indicator Unit LA-18M
(b)	Electronic Counter, Hewlett Packard, Model 5245L
(c)	Frequency Converter, Hewlett Packard, Model 5254B
(d)	Wave Analyzer, Hewlett Packard Model 302A
(e)	Wave Analyzer, Hewlett Packard Model 310A
(f)	Test Oscillator, Hewlett Packard Model 650A
(g)	Power Supply, Trygon Electronics Model HR40-750
(h)	Power Supply, Trygon Electronics Model H36-15A
(i)	Digital Voltmeter, Hewlett Packard Model 3440A
(j)	High Gain/Auto Range Unit, Hewlett Packard Model 3443A
(k)	AC-to-DC Converter, Hewlett Packard, Model 457A
(l)	Vacuum Tube Voltmeter, Hewlett Packard Model 410B
(m)	AC Voltmeter, Hewlett Packard Model 400E
(n)	Thermocouple Junction and Meter to Measure Temperature Over the Range of -20°C to 75°C
(o)	Power meter, Hewlett Packard Model 431C
(p)	Directional Coupler, Hewlett Packard Model 777D
(q)	RF Load Resistor, Sierra Model 160-500
(r)	Adjustable Line, General Radio Co. Type 874-LK20L
(s)	Adjustable RF Stub, General Radio Co. Type 874-D50L
(t)	Slotted Line, General Radio Co. Type 874-LBA
(u)	Attenuator Weinschel Model 60
(v)	Trombone Constant Impedance Adjustable Line, General Radio, Type 874-LTL
(w)	Ammeter, Weston, Model 901
(x)	Decade Resistance, General Radio Co. Type 1432-M
(y)	Oscilloscope, Tektronix Type 545 With Type CA plug in

TABLE 1-II (Continued)

Item Number	Test Item
(z)	Receiver, Nems-Clark, Type 711A with FSD-109A and RFT-106A
(aa)	Temperature Chamber, Associated Testing Laboratories, Inc. Model SLHD-8-LC
(bb)	Vibration Test Facility Consisting Of: MB Co. - Model T489 80 Channel Equalyzer/Analyzer MB Co. - Model T888 22.5 KVA Power Amplifier MB Co. - Model T66/88 Control Console MB Co. - Model C-60 6000 Force Pound Exciter B&K - Model 572/573 Vibration Control Servo A&G - Model 2020R "G" Table
(cc)	RF Detector, Telonic XD-6A
(dd)	Attenuator, NARDA Types 705, 706
(ee)	Pressure Gage, Futurecraft 90395-LOX
(ff)	SWR Meter, Hewlett Packard Model 415B or 415D
(gg)	Tee, General Radio, Type 874-T or 874-TL
(hh)	Double Stub Tuner, NARDA Model 903N
(ii)	20-CM Adjustable Stub, General Radio 874-D20L

NOTE: Items (cc), (gg), and (hh) do not require certification.

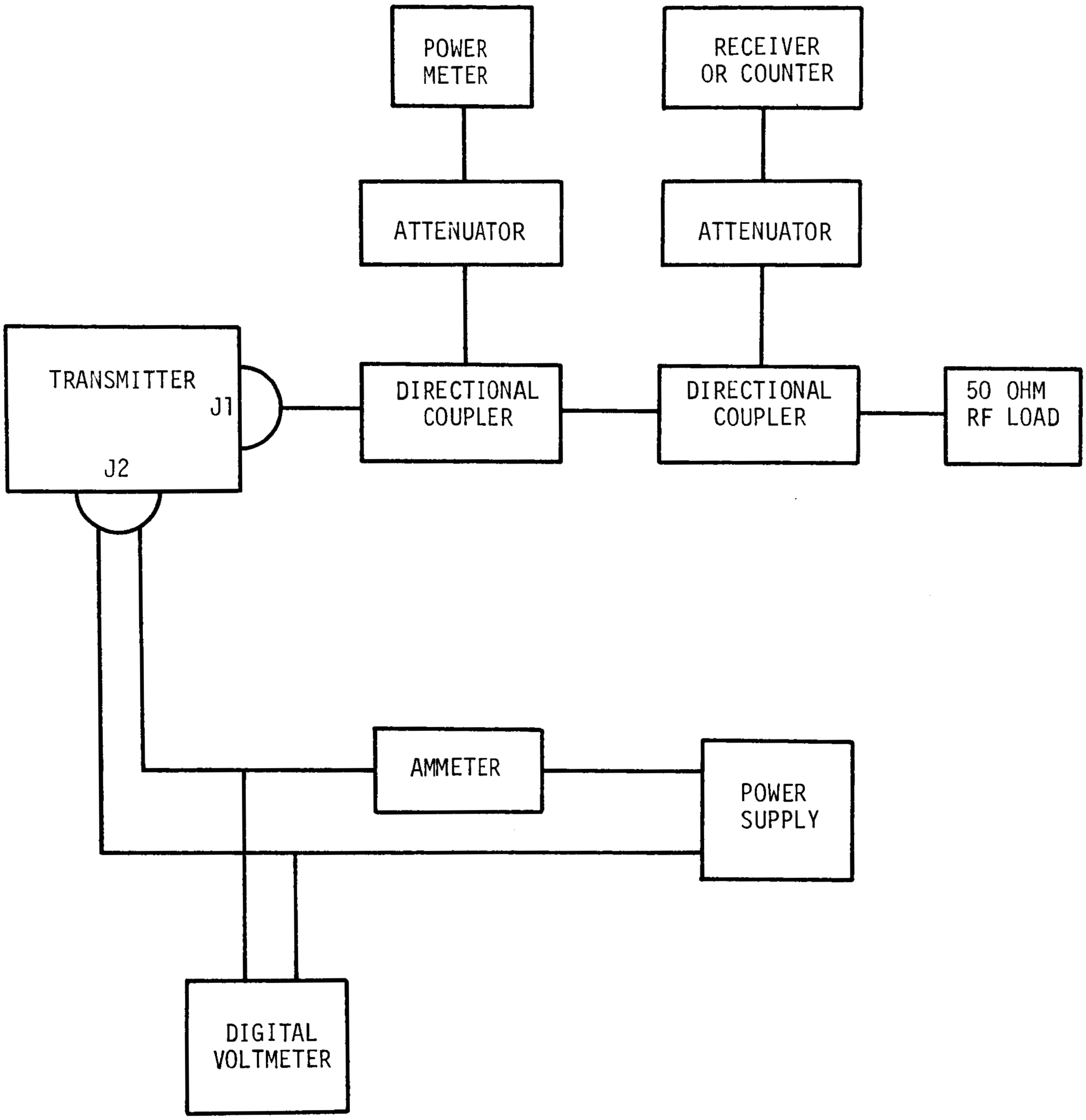
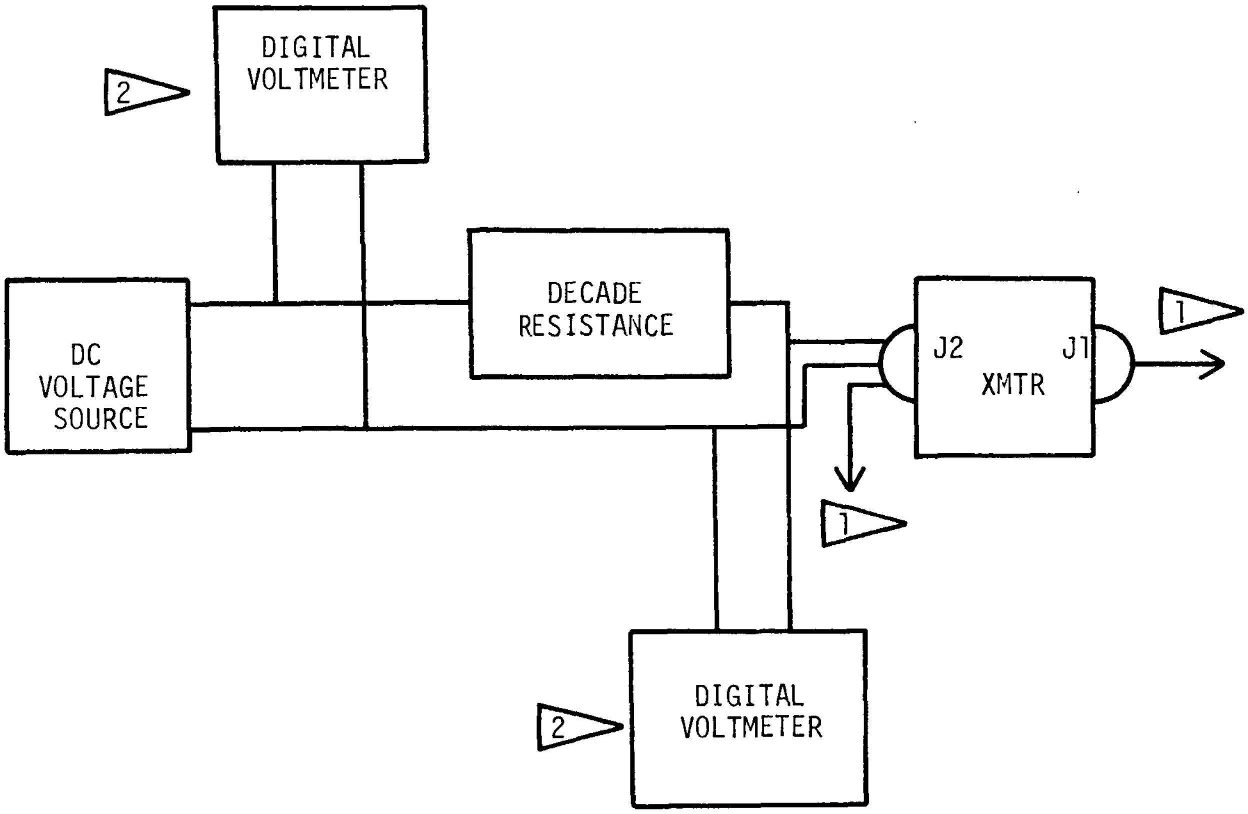


FIGURE 1-1 - Basic Test Setup, Output Power Frequency Stability, Efficiency, Warm-up Time Test Setup.

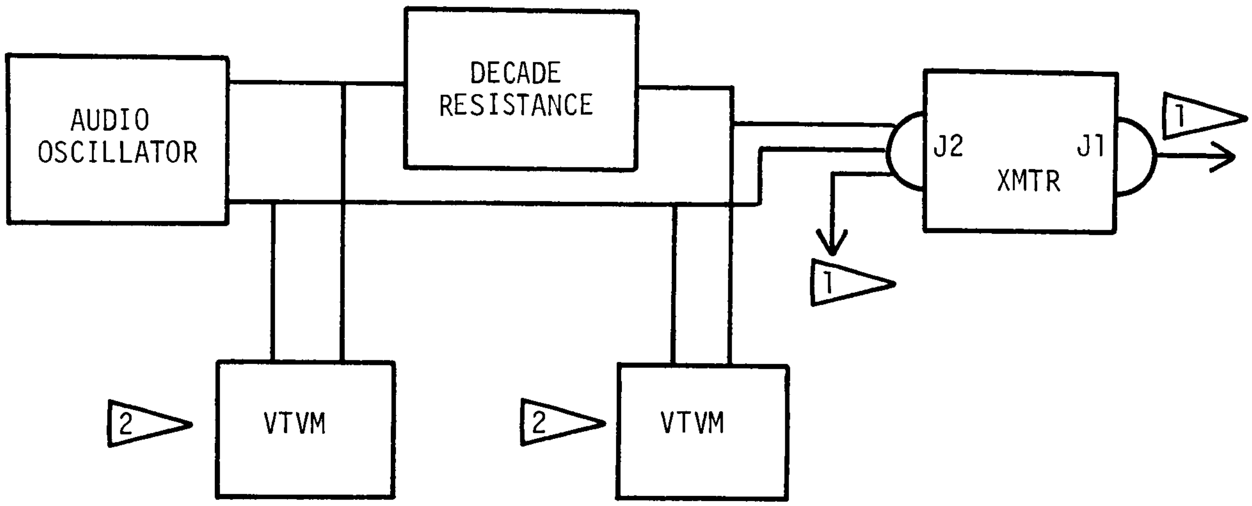


NOTES

1 Supply power and RF output connected as per Figure 1.

2 Use same digital voltmeter by alternating connections.

FIGURE 1-2 - DC Input Impedance Test Setup

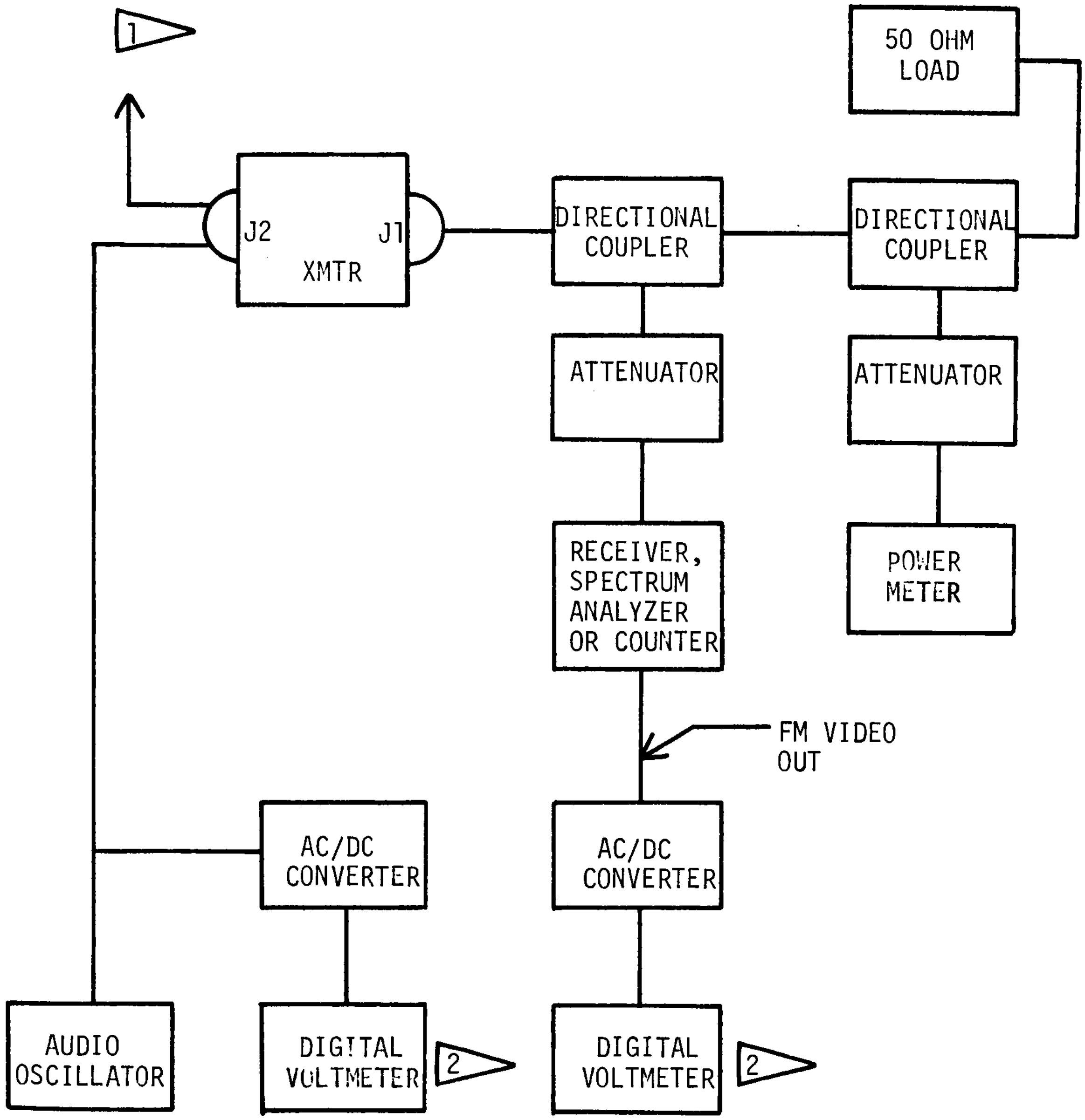


NOTES

1 Supply power and RF output connected per Figure 1.

2 Use same VTVM by alternating connections.

FIGURE 1-3 - AC Input Impedance Test Setup

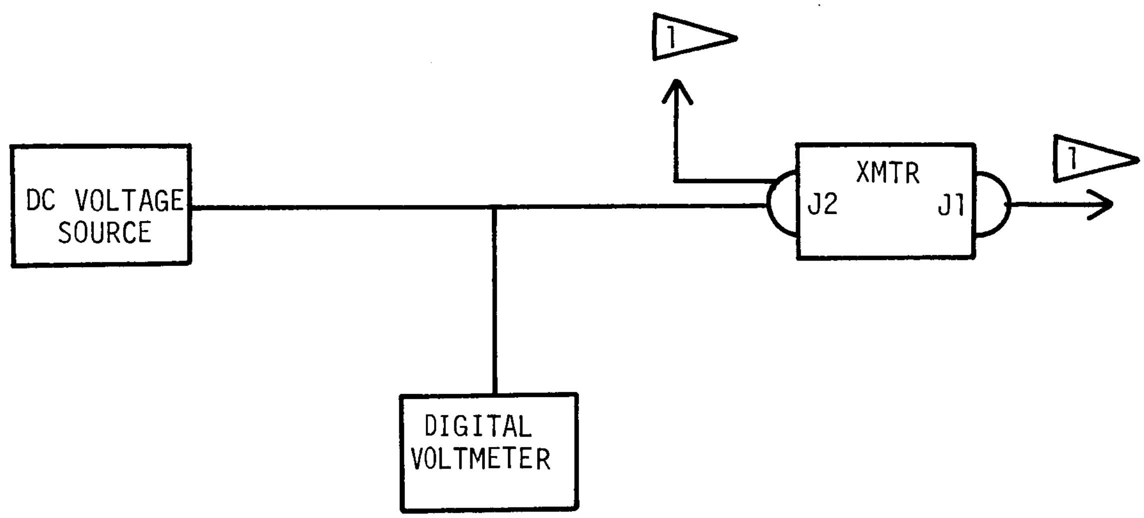


NOTES

1. Power supply connected per Figure 1.

2. Use same AC/DC converter and digital voltmeter by alternating connections.

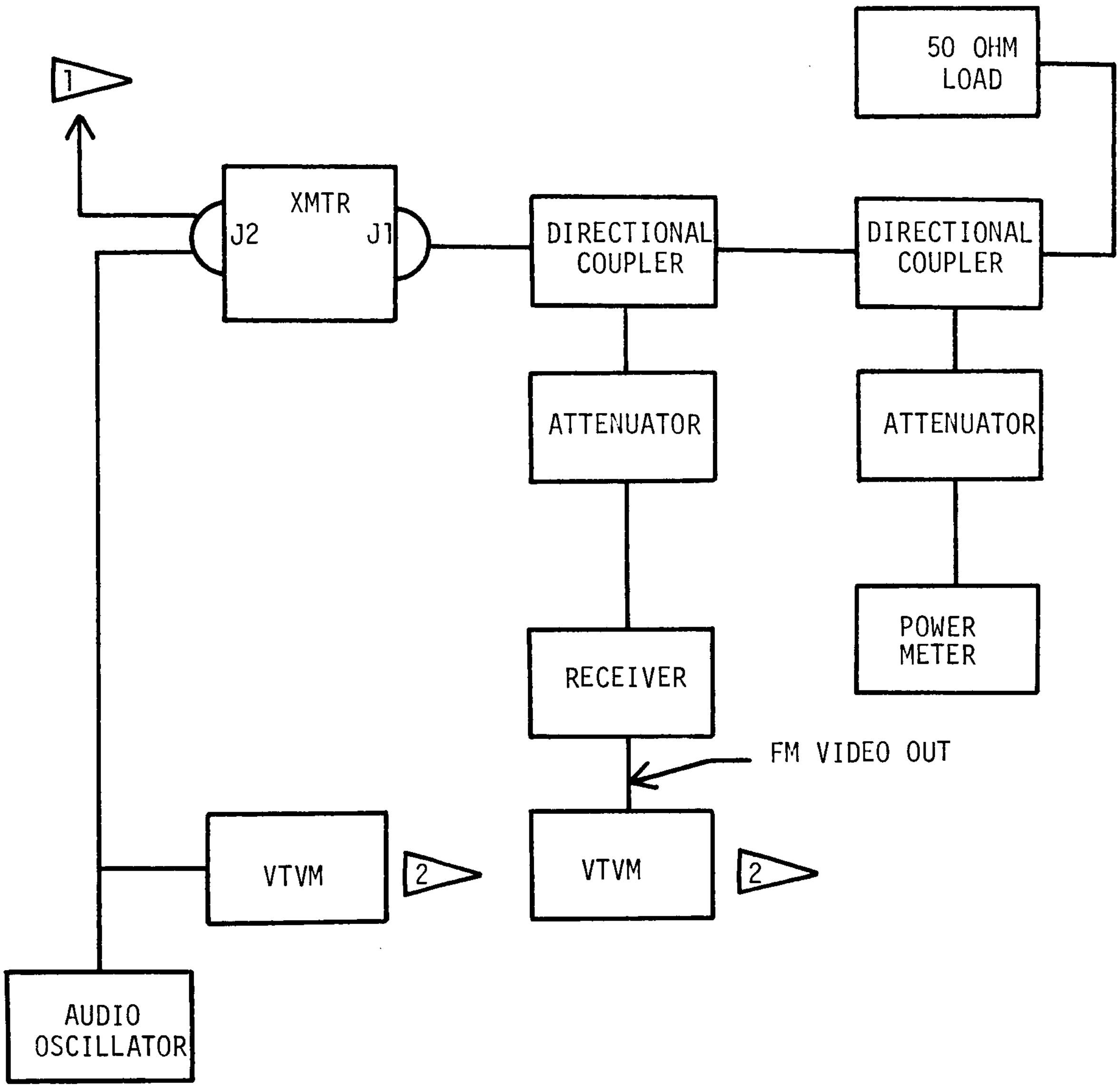
FIGURE 1-4 - Deviation Sensitivity and AC Deviation Linearity Test Setup



NOTE

1 Supply power and RF output connected per Figure 1.

FIGURE 1-5 - DC Sensitivity Test Setup

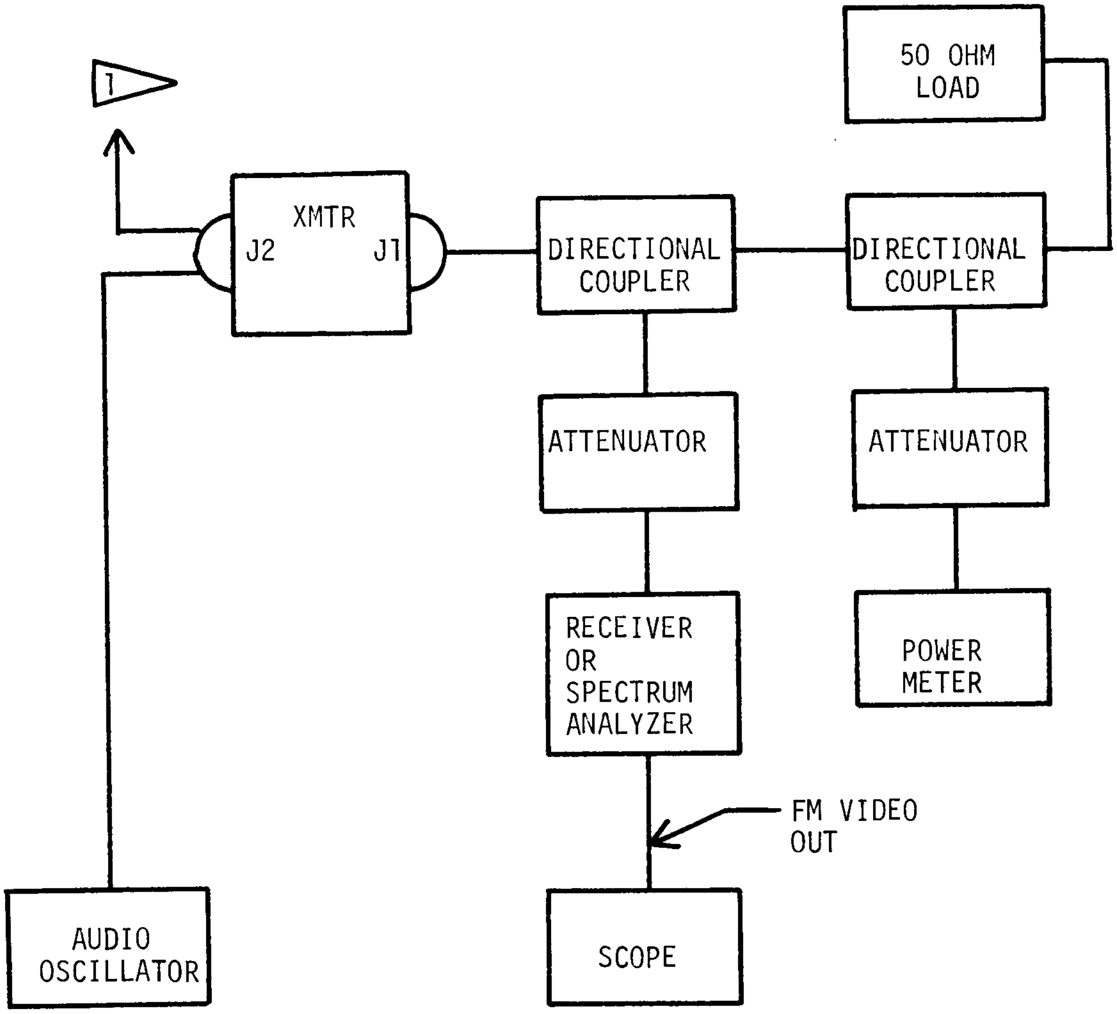


NOTES

1 Power supply connections per Figure 1.

2 Use same VTVM by alternating connections.

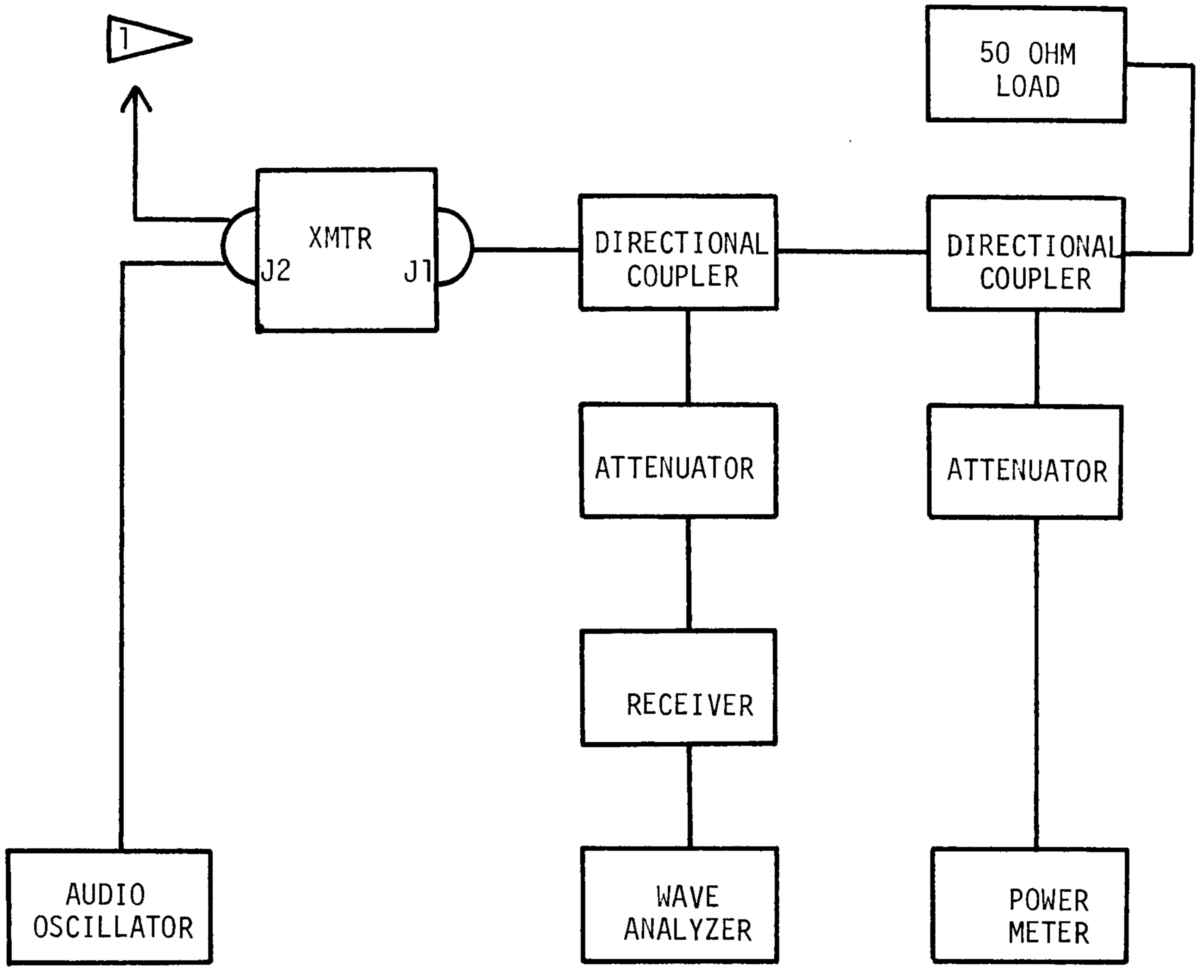
FIGURE 1-6 - Frequency Response Test Setup



NOTE

1 Power supply connections per Figure 1.

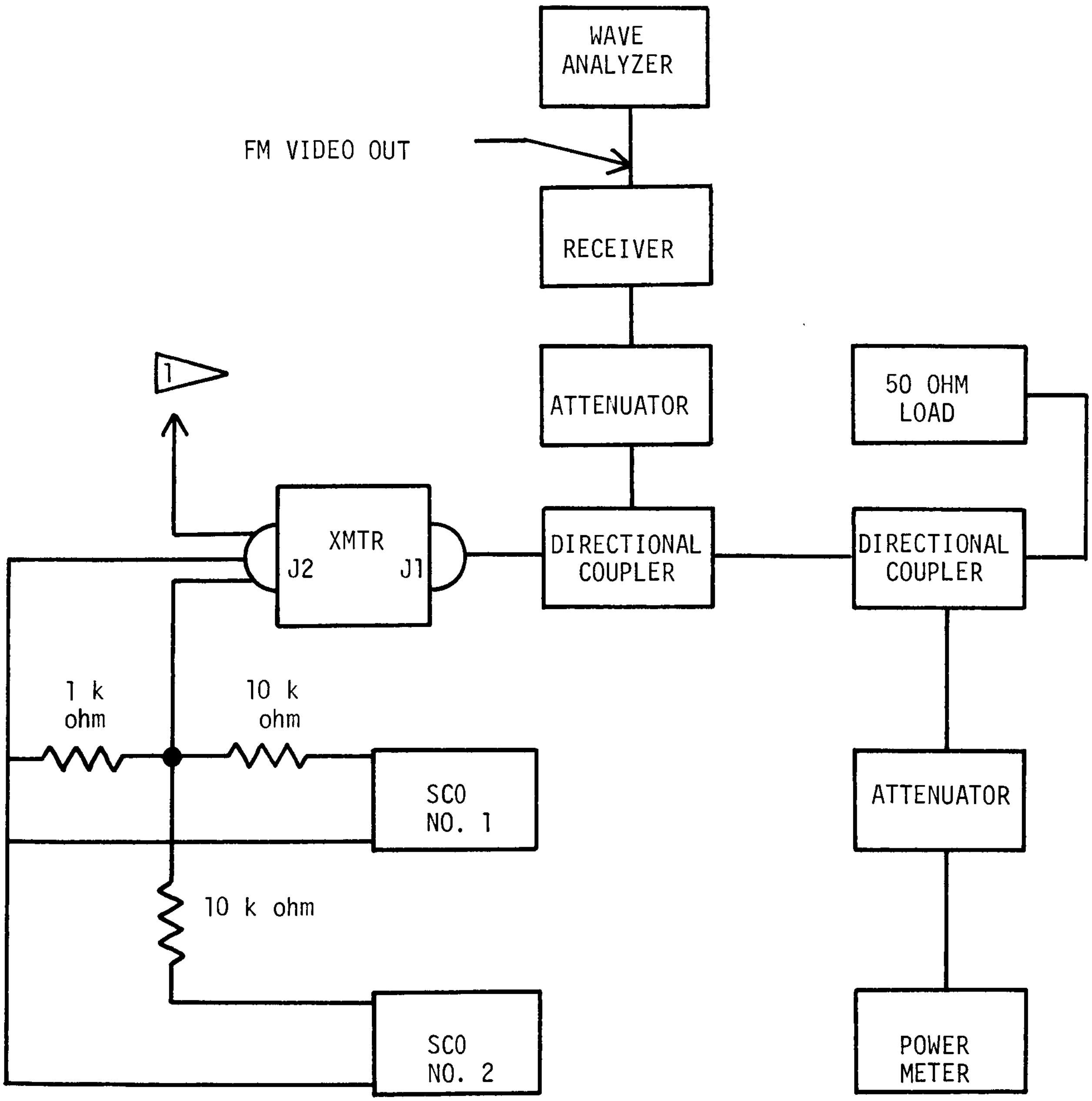
FIGURE 1-7 - Incidental Frequency Modulation Test Setup



NOTE

1 Power connected per Figure 1.

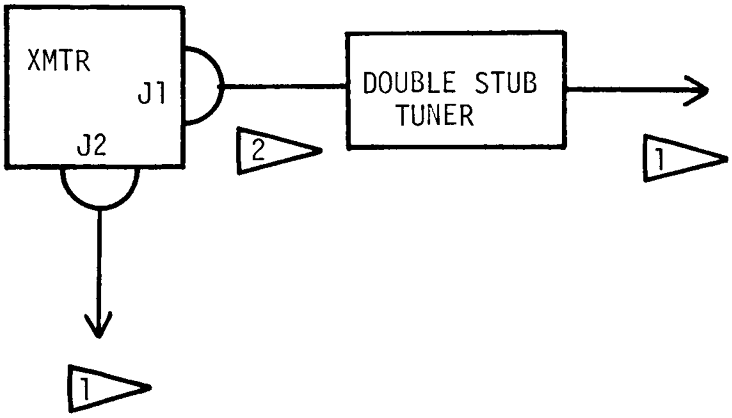
FIGURE 1-8 - Modulation Distortion Test Setup



NOTE

1 Supply power connected per Figure 1.

FIGURE 1-9 - Intermodulation Test Setup

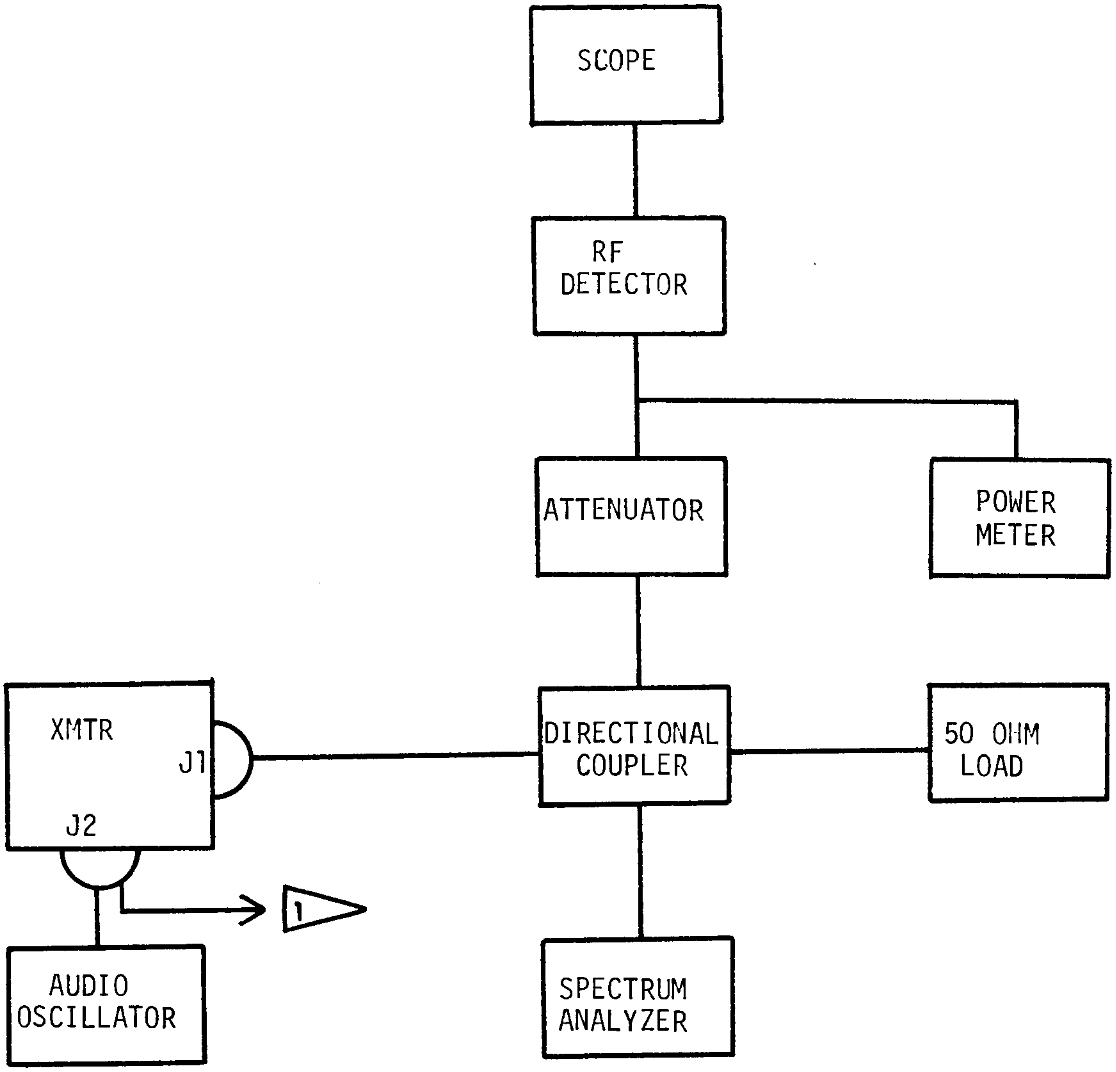


NOTES

1 Supply power and RF output power connected per Figure 1.

2 VSWR input to stub tuner is pre-adjusted to 1.8:1 before connection to transmitter.

FIGURE 1-10 - VSWR Test Setup



NOTE

1 Supply power connected per Figure 1.

FIGURE 1-11 - Incidental Amplitude Modulation Test Setup

SECTION 2

TEST DATA

2.0 INTRODUCTION

This section contains the original test data sheets and test equipment lists as recorded by Boeing Quality control. The paragraph numbers on the data sheets refer to the paragraph numbers in the preceding test procedure. It will be noted that only tests 1.3.2.1 (a) and (b) through 1.3.2.12 were conducted. No environmental tests were conducted.

TABLE 2-I ORIGINAL TEST DATA

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV 2 65	PAGE 1 OF
SK/LSTCH90-1D E		H603099		

DATA SHEET

		RESULTS	CHECK: DATE & SHOP	CHECK: DATE & INSP.	CHECK: DATE & CUST.
1.3.2.1	TEST SETUP				
1.3.2.1 (B)	POWER GROUND – CHASSIS GROUND	>500 MEG OHM			
	INDICATOR GROUND – CHASSIS GROUND	>500 MEG OHM		MAR 29 1968	
	POWER GROUND – EXCITER GROUND	~100 MEG OHM			
1.3.2.7	WARM UP TIME				
	@ 3 MINUTES POWER OUTPUT	21.6 WATTS			
	OUTPUT FREQUENCY	2277.576215			
	@ 6 MINUTES POWER OUTPUT	22.8 WATTS			
	OUTPUT FREQUENCY	2277.577453			
	@ 9 MINUTES POWER OUTPUT	22.8 WATTS		MAR 29 1968	
	OUTPUT FREQUENCY	2277.581454			

PAGE 1 OF	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	CONTRACT NO.
	SK/LSTCH90-1D E	10 WATT TRANSMITTER		H603099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV. 2 65	PAGE 2 OF
[illegible]		11L03099		

DATA SHEET

	RESULTS	CHECK DATE & SHOP	DATE & INSP.	DATE & CUST.
1.3.2.3 THE ADJUSTABLE ATTENUATOR IS SET TO GIVE A READING OF 31.75 DB WHEN THE TRUE OUTPUT POWER.				
SUPPLY VOLTAGE @ 28 VDC				
CURRENT	7.15 AMP			
FREQUENCY	2277.563628			
POWER 0.675	20.25 WATT			
EFFICIENCY	10.1 %			
SUPPLY VOLTAGE @ 32 VDC				
CURRENT	7.10 Amp			
FREQUENCY	2277.564731			
POWER 0.678	20.35 WATT			
EFFICIENCY	8.15%			
SUPPLY VOLTAGE @ 25 VDC				
CURRENT	7.3 AMP			
FREQUENCY	2277.562355			
POWER 0.560	16.80 WATT			
EFFICIENCY	9.22%	[illegible]		
1.3.2.4 INPUT IMPEDANCE				
1.3.2.4.1 DC INPUT IMPEDANCE	13.3 Kohms	[illegible] MAR 29 1968		

PAGE	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
2	[illegible]	20 WATT TRANSMITTER		11L03099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV. 2 65	PAGE 3 OF
5K/1STC1190-1		H103099		

DATA SHEET

		RESULTS	DATE & SHOP	DATE & INSP.	DATE & CUST.
1.3.2.4.2	AC INPUT IMPEDANCE				
	@ 300 Hz	13.7 Kohms			
	@ 1 KHz	13.5 Kohms			
	@ 10 KHz	13.5 Kohms			
	@ 50 KHz	13.2K ohms			
	@ 100 KHz	13.6K ohms		MAR 29 1968	
	@ 200 KHz	10.4K ohms	KCC		
1.3.2.5	DEVIATION SENSITIVITY				
1.3.2.5.1	AC SENSITIVITY				
	@ 28VDC				
	MODULATION INPUT VOLTAGE	~~0.49~~ 0.49 VAC			
	DEVIATION SENSITIVITY	204 KHz/VOLT			
	@ 32VDC				
	MODULATION INPUT VOLTAGE	0.49 VAC			
	DEVIATION SENSITIVITY	204 KHz/VOLT			
	@ 25VDC				
	MODULATION INPUT VOLTAGE	0.495 VAC		MAR 29 1968	
	DEVIATION SENSITIVITY	203 KHz/VOLT	KCC		
1.3.2.5.2	DC SENSITIVITY				
	@ 28VDC +1.0 VDC	2277.703554			
	-1.0 VDC	2277.423222			
	@ 32VDC +1.0 VDC	2277.704758		MAR 29 19	
	-1.0 VDC	2277.424371			

PAGE	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
3	373878	Transmitter		H103099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV. 2/65	PAGE 4 OF
SK/LSTCH90-1B		HL03099		

DATA SHEET

		RESULTS	CHECK DATE & SHOP	DATE & INSP.	DATE & CUST.
1.3.2.5.2 (CONT.)					
@ 25.5 VDC.	+1.0 VDC	2277.702822		MAR 29 1968	
	-1.0 VDC	2277.422117	LTC	FBT 49	
1.3.2.6 AC DEVIATION LINEARITY					
@ 300 Hz	MODULATION INPUT Vi	VIDEO OUTPUT Eo			
	0.250 VDC	0.249 VDC			
125 K Hz DEVIATION @ 300 Hz = 0.16%	0.500 VDC	0.498 VDC			
	0.625 VDC	0.625 VDC			
500 K Hz DEVIATION @ 300 Hz = 0.25%	0.750 VDC	0.750 VDC			
	1.000 VDC	0.999 VDC			
	1.250 VDC	1.248 VDC			
	1.500 VDC	1.501 VDC			
	1.750 VDC	1.751 VDC			
	2.000 VDC	2.003 VDC		MAR 29 1968	
	2.250 VDC	2.255 VDC			
	2.500 VDC	2.500 VDC	LTC		
@ 10K Hz					
	0.350 VDC	0.250 VDC			
125 K Hz DEVIATION @ 10K Hz = 0.08%	0.500 VDC	0.499 VDC			
	0.625 VDC	0.623 VDC			
500 K Hz DEVIATION @ 10K Hz = 0.312%	0.750 VDC	0.746 VDC			
	1.000 VDC	0.996 VDC			
	1.250 VDC	1.252 VDC			
	1.500 VDC	1.498 VDC			

PAGE 4 OF	PART NO. 3/28/68	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
	SK/LSTCH90-1B	20 WATT TRANSMITTER		HL03099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV. 2 65	PAGE 5 OF
SK/LSTCH90-1E		H603099		

DATA SHEET

		RESULTS	CHECK DATE & SHOP	CHECK DATE & INSP.	CHECK DATE & CUST.
1.3.2.6 (CONTINUED) @ 10KHz					
	1.750 VDC	1.754 VDC			
	2.000 VDC	2.006 VDC		MAR 29 1968	
	2.250 VDC	2.252 VDC			
	2.500 VDC	2.502 VDC		FRT 49	
@ 100KHz					
	0.250 VDC	0.258 VDC			
125 KHz DEVIATION @ 100KHz = 0.08%	0.500 VDC	0.513 VDC			
	0.625 VDC	0.639 VDC			
500 KHz DEVIATION @ 100KHz = 0.36%	0.750 VDC	0.765 VDC			
	1.000 VDC	1.014 VDC			
	1.250 VDC	1.270 VDC			
	1.500 VDC	1.524 VDC			
	1.750 VDC	1.772 VDC			
	2.000 VDC	2.016 VDC			
	2.250 VDC	2.259 VDC		MAR 29 1968	
	2.500 VDC	2.500 VDC		FRT 49	

P

PAGE 5 OF	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
	SK/LSTCH90-1E	20 WATT TRANSMITTER		H603099

TBR 25

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS RESEARCH RECORDS SYSTEM S-812-65-33 REV 2-65	PAGE 6 OF
SK/LST0490-1 E 3/28/68		H603099		

DATA SHEET

	RESULTS		CHECK		
	RECEIVER OUTPUT	dB	MFG & SHOP	DATE & INSP.	DATE & CUST.
1.3.2.7 FREQUENCY RESPONSE					
RECEIVER TUNING OFFSET -0- 50 Hz	1.033	+0.3			
VIDEO FILTERING 1000 KHz 200 Hz	1.043	+0.4			
IF BANDWIDTH 3-3 MC 500 Hz	1.040	+0.35			
MICROVOLT LEVEL 100 KV 1 KHz	1.032	+0.3			
5 KHz	0.975	-0.2			
10 KHz	0.968	-0.3			
REFERENCE POINT 50 KHz	1.000	0.0			
100 KHz	1.046	+0.4			
150 KHz	1.073	+0.6			
200 KHz	1.064	+0.5			
250 KHz	1.113	+1.05			
300 KHz	1.089	+0.7			
350 KHz	1.065	+0.6			
400 KHz	0.975	-0.2			
450 KHz	0.885	-1.1		MAR 29 1968	
500 KHz	0.796	-1.95			
1.3.2.8 INCIDENTAL FREQUENCY MODULATION					
PEAK TO PEAK DEVIATION	6.4 KHz				
VIDEO BANDWIDTH	500 KHz				
RECEIVER INPUT SIGNAL LEVEL	100K MICROVOLTS			MAR 29 1968	

PAGE	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
6	SK/LST0490-1 E 3/28/68	20 WATT TRANSMITTER		H603099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV. 2-65	PAGE 7 OF
5K/LSTCH90-E		H603099		

DATA SHEET

	RESULTS	CHECK DATE & SHOP	CHECK DATE & INSP.	CHECK DATE & CUST.
1.3.2.9 MODULATION DISTORTION				
@ 5KHz FUNDAMENTAL MODULATING FREQUENCY	dB			
SECOND HARMONIC	-39.0			
THIRD HARMONIC	-46.0			
@ 10KHz FUNDAMENTAL MODULATING FREQUENCY				
SECOND HARMONIC	-39.0			
THIRD HARMONIC	-45.5			
@ 25 KHz FUNDAMENTAL MODULATING FREQUENCY				
SECOND HARMONIC	-40.5			
THIRD HARMONIC	-45.5			
@ 50 KHz FUNDAMENTAL MODULATING FREQUENCY				
SECOND HARMONIC	-39.5			
THIRD HARMONIC	-47.0			
@ 100KHz FUNDAMENTAL MODULATING FREQUENCY				
SECOND HARMONIC	-40.0		MAR 29 1968	
THIRD HARMONIC	-47.0		BT 49	

PAGE 7 OF	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
	5K/LSTCH90-E	20 WATT TRANSMITTER		H603099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-33 REV. 2.65	PAGE 8 OF
SN/LSTCH90-1 3/28/8		H603099		

DATA SHEET

		RESULTS	CHECK DATE & SHOP	DATE & INSP.	DATE & CUST.
6.3.2.10 INTERMODULATION DISTORTION					
TABLE I					
COMBINATION #1	SUM	-40dB			
	DIFFERENCE	-40dB			
COMBINATION #2	SUM	-40.5 dB			
	DIFFERENCE	-40.0 dB			
COMBINATION #3	SUM	-41.1 dB			
	DIFFERENCE	-41.0 dB			
COMBINATION #4	SUM	-40.5 dB		MAR 29 1968	
	DIFFERENCE	-42.0 dB	W.T.	FBT 49	

PAGE	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
8	SN/LSTCH90-1 D 3/28/8	10 WATT TRANSMITTER		H603099

PART NO. 3K/LSTC490-1 E	SERIAL NO. OR LOT NO.	ORDER NO. HLC3099	BOEING LAUNCH SYSTEMS RECORDS SYSTEM S-812-55-33 REV. 2-65	PAGE 9 OF

DATA SHEET

			RESULTS	DATE & OPER.	CHECK DATE & INSP.	DATE & CUST.
1.3.2.11	LOAD IMPEDANCE					
1.3.2.11.1	1.8 VSWR					
	@ 28 VDC	SUPPLY CURRENT	7.4 AMP			
		OUTPUT POWER	17.9 WATT			
		OUTPUT FREQUENCY	2277.576128			
	@ 32 VDC	SUPPLY CURRENT	7.3 AMP			
		OUTPUT POWER	17.4 WATT			
		OUTPUT FREQUENCY	2277.577756			
	@ 25.5 VDC	SUPPLY CURRENT	7.75 AMP			
		OUTPUT POWER	17.9 WATT			
		OUTPUT FREQUENCY	2277.575898	WCL	MAR 29 1968	
1.3.2.11.2	OPEN CIRCUIT					
	~~BEFORE~~ 50 ohm LOAD DISCONNECTED					
		OUTPUT POWER	20.4 WATT			
		SUPPLY CURRENT	7.15 AMP			
		CARRIER FREQUENCY	2277.563892			
	WITH 50 ohm LOAD RECONNECTED					
		OUTPUT POWER	20.1 WATT			
		SUPPLY CURRENT	7.05 AMP			
		CARRIER FREQUENCY	2277.56407	D WCL	MAR 29 1968	

PAGE 9 OF	PART NO. 372818 LSTC490-1 E	NOMENCLATURE 20 WATT TRANSMITTER	SERIAL NO. OR LOT NO.	HLC3099

PART NO.	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS RECORDS SYSTEM S-312-65-33 REV. 2 55	PAGE 10 OF
3?/1STOH90-1 E 3/29/68		11103099		

DATA SHEET

		RESULTS	DATE & SHOP	DATE & INSP.	DATE & CUST.
1.3.2.11.3	SHORT CIRCUIT				
	INITIAL CONFIGURATION				
	OUTPUT POWER	19.8 WATTS			
	SUPPLY CURRENT	7.05 AMPS			
	CARRIER FREQUENCY	2277.563789			
	AFTER SHORT.				
	OUTPUT POWER	20.1 WATT			
	OUTPUT FREQUENCY	2277.563581			
	SUPPLY CURRENT	7.1 AMPS	WJC	MAR 29 1968	
1.3.2.12	INCIDENTAL AMPLITUDE MODULATION				
1.3.2.12 (h)	PEAK TO PEAK	0.5%			
1.3.2.12 (i)	PEAK TO PEAK	2.5%	WJC	MAR 29 1968	

PAGE	PART NO.	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NO.
10	?1/1STO?-1 E 3/29/68	20 WATT TRANSMITTER		11103099

TABLE 2-II DETAILED EQUIPMENT LIST

PART NUMBER	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-32 REV. 2 65	PAGE 2 OF 3
SK/LST0490-1B		H603099		

TEST EQUIPMENT CONFIGURATION LOG

PART NUMBER	ENGR. CONFIG.	NOMENCLATURE	SERIAL NO.	CALIBRATION LAST	CALIBRATION DUE	UNPLANNED EVENT S/N	DATE & SHOP	DATE & INSP.	DATE & CUST.
457A	—	AC/DC CONVERTER	C17431	FEB 1968	APR 1968		470-30-5210	FBT 49	MAR 29 1968
R1037B	—	RECEIVER	474	JAN 1968	JULY 1968		R. Freeburg 470-30-5210	FBT 49	MAR 29 1968
RFT/06A	—	RF TUNER	128	NOV 1967	MAY 1968		R. Freeburg 470-30-5210	FBT 49	29 1968
3.3 MC FSD	—	PLUG IN FILTER	123	JAN 1968	JULY 1968		R. Freeburg	FBT	
1037	—	COUNTER	555	JAN 1968	MAY 1968		R. Freeburg	FBT 49	MAR 29 1968
SPA-4A	—	SPECTRUM ANALYZER	91	FEB 1968	APR 1968		R. Freeburg	FBT	MAR 29 1968
1432P	—	DECADE RESISTOR	3-5992	OCT 1967	APR 1968		R. Freeburg 470-30-5210	FBT 49	MAR 29 1968
H02K	—	DIGITAL AC VOLTMETER	536-01230	FEB 1968	MAY 1968		R. Freeburg 470-30-5210		MAR 29 1968
302A	—	WAVE ANALYZER	437-04143	JAN 1968	MAY 1968		R. Freeburg 470-30-5210	FBT 49	MAR 29 1968
310A	—	WAVE ANALYZER	415-00733	NOV 1967	MAY 1968		R. Freeburg 470-30-5210	FBT	MAR 29 1968
651A		OSCILLATOR	233-12851	NOV 1967	MARCH 29 1968		R. Freeburg 470-30-5210	FBT 49	MAR 29 1968
431B	—	POWER METER	310-10282	OCT 1967	APR. 1968		R. Freeburg 470-30-5210	FBT	MAR 29 1968
478A	—	THERMISTOR MOUNT	3748	SEPT 1967	SEPT 1968		R. Freeburg	FBT 49	MAR 29 1968
545B		OSCILLOSCOPE	000799	MARCH 1968	JULY 1968		R. Freeburg 470-30-5210	FBT	MAR 29 1968
TYPE CA		PLUG IN UNIT	009872	FEB 1968	JULY 1968		R. Freeburg	FBT	MAR 29 1968
XD-6A		DETECTOR	041265	N/A	N/A		R. Freeburg	FBT 49	MAR 29 1968

PAGE 2 OF 3	PART NUMBER	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NUMBER
	SK/LST0490-1B 3/28/8	20 WATT TRANSMITTER		H603099

PART NUMBER	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-32 REV. 2 65	PAGE 1 OF 3
SK/LST0490-1D		H603099		

TEST EQUIPMENT CONFIGURATION LOG

PART NUMBER	ENGR. CONFIG.	NOMENCLATURE	SERIAL NO.	CALIBRATION LAST	CALIBRATION DUE	UNPLANNED EVENT S/N	DATE & SHOP	DATE & INSP.	DATE & CUST.
777D	—	DIRECTIONAL COUP	01624	APR 1967	APR 1968		R. Freeburg 470-30-5210	FBT 49 MAR 29 1968	
824 GAL	—	ADJUSTABLE ATTENUATOR	N/A	N/A	N/A		R. Freeburg 470-30-5210	MAR 29 1968	
394A	—	VARIABLE ATTENUATOR	1204	JAN 1968	JAN 1969		R. Freeburg 470-30-5210	MAR 29 1968	
1600-100FM	—	COAXIAL TERMINATION	388	JUNE 1967	JUNE 1968		[illegible]	[illegible]	
8614A	—	SIGNAL GENERATOR	343002 48	FEB 1968	AUG. 1968		R. Freeburg	FBT 49 MAR 29 1968	
431C	—	POWER METER	618-01202	OCT 1967	APR 1968		R. Freeburg	FBT MAR 29 1968	
M36-10A	—	POWER SUPPLY	11075 H	DEC 1967	MAY 1968		R. Freeburg 470-30-5210	FBT 49 MAR 29 1968	
428B	—	AMMETER	13102172	JAN 1968	APR 1968		R. Freeburg 470-30-5210	FBT MAR 29 1968	
3440A	—	DIGITAL VOLTMETER	531249	JAN 1968	JUL 1968		R. Freeburg 470-30-5210	FBT 49 MAR 29 1968	
3443A	—	HIGH GAIN AUDIO RANGE UNIT	531247	JAN 1968	JUL 1968		R. Freeburg 470-30-5210	FBT MAR 29 1968	
5245L	—	ELECTRONIC COUNTER	430-01899	FEB 1968	MAY 1968		R. Freeburg 470-30-5210	FBT 49 MAR 29 1968	
5254A	—	FREQUENCY CONVERTOR	429 00154	JAN 1968	MAY 1968		R. Freeburg 470-30-5210	MAR 29 1968	
11K40-750	—	POWER SUPPLY	21758E	JAN 1968	JUL 1968		R. Freeburg 470-30-5210	FBT 49 MAR 29 1968	
1432-M	—	DECADE RESISTOR	2032	NOV 1967	MAY 1968		R. Freeburg 470-30-5210	FBT MAR 29 1968	
650A		TEST OSCILLATOR	331240	OCT 1967	APR 1968		R. Freeburg 470-30-5210	FBT MAR 29 1968	
400E		VOLTMETER	53C-02651	JAN 1968	APR 1968		R. Freeburg 470-30-5210	MAR 29 1968	

PAGE 1 OF 3	PART NUMBER	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NUMBER
	SK/LST0490-1D IBR 22 3/24/8	20 WATT TRANSMITTER		H603099

PART NUMBER	SERIAL NO. OR LOT NO.	ORDER NO.	BOEING LAUNCH SYSTEMS BRANCH RECORDS SYSTEM S-812-65-32 REV. 2 65	PAGE 3 OF 3
SK/LST0490-1D	X	H603099		

TEST EQUIPMENT CONFIGURATION LOG

PART NUMBER	ENGR. CONFIG.	NOMENCLATURE	SERIAL NO.	CALIBRATION		UNPLANNED EVENT S/N	DATE & SHOP	DATE & INSP.	DATE & CUST.
				LAST	DUE				
478A	—	THERMISTER MOUNT	13448	JUNE 1967	JUNE 1968		Freeburg 470-30-5210	FBT 49 MAR 29 1968	
874 LBA	—	SLOTTED LINE	BC 591739	AUG 1967	AUG 1968		R. Freeburg 470-30-5210	MAR 29 1968	
874 D20L	—	ADJ. STUB	NAS48279	JAN 1968	JULY 1968		R. Freeburg 470-30-5210	FBT 49 MAR 29 1968	

P

PAGE 3 OF 3	PART NUMBER	NOMENCLATURE	SERIAL NO. OR LOT NO.	ORDER NUMBER
	SK/LST0490-1D (IBR 25 3/28/68)	20 TT TRANSMITTER	X	H603099